

Listing Of Claims

- 1 1. (Original) A light-emitting device, comprising:
2 an active region configured to generate light in response to injected charge;
3 and
4 a tunnel junction structure located to inject charge into the active region and
5 including an n-type tunnel junction layer of a first semiconductor material, a p-type
6 tunnel junction layer of a second semiconductor material and a tunnel junction
7 between the tunnel junction layers, the first semiconductor material including gallium
8 (Ga), nitrogen (N), arsenic (As) and a Group VI dopant.
- 1 2. (Original) The light-emitting device of claim 1, in which the n-type
2 tunnel junction layer is located between the p-type tunnel junction layer and the active
3 region.
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- 1 3. (Original) The light-emitting device of claim 1, in which the p-type
2 tunnel junction layer is disposed between the n-type tunnel junction layer and the
3 active region.
- 1 4. (Original) The light-emitting device of claim 1, in which the Group VI
2 dopant is chosen from sulfur (S), selenium (Se) and tellurium (Te).
- 1 5. (Original) The light-emitting device of claim 4, in which the first
2 semiconductor material consists essentially of gallium indium nitride arsenide $\text{Ga}_{1-x}\text{In}_x\text{NAs}$ in which $x \geq 0$.
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- 1 6. (Original) The light-emitting device of claim 1, in which the second
2 semiconductor material includes gallium, nitrogen, arsenic and antimony.

1 7. (Original) The light-emitting device of claim 5, in which:
2 an electromagnetic field intensity distribution exists in the light-emitting
3 device; and
4 the tunnel junction is located at a minimum in the electromagnetic field
5 intensity distribution.

1 8. (Original) The light-emitting device of claim 1, in which:
2 the first semiconductor material consists essentially of gallium indium nitride
3 arsenide GaInNAs; and
4 the second semiconductor material consists essentially of gallium nitride
5 arsenide antimonide GaNAsSb.

1 9. (Original) The light-emitting device of claim 8, in which:
2 the first semiconductor material consists essentially of gallium indium nitride
3 arsenide $\text{Ga}_{1-w}\text{In}_w\text{N}_x\text{As}_{1-x}$, in which $w \leq 0.4$ and $x \leq 0.15$; and
4 the second semiconductor material consists essentially of gallium nitride
5 arsenide antimonide $\text{GaN}_y\text{As}_{1-y-z}\text{Sb}_z$ in which $y \leq 0.15$ and $z \leq 0.3$.

1 10. (Original) The light-emitting device of claim 1, structured to generate
2 light having a wavelength between 620 nm and 1650 nm.

1 11. (Original) The light-emitting device of claim 1, in which the second
2 semiconductor material comprises at least one of indium, antimony and bismuth.

1 12. (Original) A method of making a tunnel junction structure, the method
2 comprising:
3 providing a substrate;
4 forming over the substrate an n-type tunnel junction layer of a first
5 semiconductor material, the first semiconductor material including gallium (Ga),
6 nitrogen (N), arsenic (As) and a Group VI dopant; and
7 forming over the substrate a p-type tunnel junction layer of a second
8 semiconductor material juxtaposed with the n-type tunnel junction layer to form the
9 tunnel junction.

1 13. (Original) The method of claim 12, in which:
2 the second semiconductor material comprises gallium and two or more of
3 nitrogen, arsenic, antimony and bismuth; and
4 the method additionally comprises doping the second semiconductor material
5 p-type.

1 14. (Original) The method of claim 12, further comprising:
2 doping the first semiconductor material n-type using a Group VI dopant
3 chosen from sulfur (S), selenium (Se) and tellurium (Te).

1 15. (Original) A method for generating light, the method comprising:
2 forming an optical cavity;
3 locating an active region in the optical cavity, the active region configured to
4 generate light in response to injected current;
5 forming a tunnel junction structure located to inject charge into the active
6 region, including:
7 forming an n-type tunnel junction layer of a first semiconductor
8 material including gallium (Ga), nitrogen (N), arsenic (As) and a Group VI
9 dopant and
10 forming a p-type tunnel junction layer of a second semiconductor
11 material juxtaposed with the n-type tunnel junction layer to create a tunnel
12 junction; and
13 injecting current into the active region using the tunnel-junction
14 structure.

1 16. (Original) The method of claim 15, in which the active region is
2 configured to generate light having a wavelength between 620 nm and 1650 nm.

1 17. (Original) The method of claim 15, in which the Group VI dopant is
2 chosen from sulfur (S), selenium (Se) and tellurium (Te).

- 1 18. (Original) A tunnel junction structure, comprising:
2 an n-type tunnel junction layer of a first semiconductor material including
3 gallium (Ga), nitrogen (N), arsenic (As) and a Group VI dopant;
4 a p-type tunnel junction layer of a second semiconductor material; and
5 a tunnel junction between the tunnel junction layers.
- 1 19. (Original) The tunnel junction structure of claim 18, in which the
2 Group VI dopant is chosen from sulfur (S), selenium (Se) and tellurium (Te).
- 1 20. (Original) The tunnel junction structure of claim 18, in which the first
2 semiconductor material consists essentially of gallium indium nitride arsenide $\text{Ga}_{1-x}\text{In}_x\text{NAs}$ in which $x \geq 0$.
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- 1 21. (Original) The tunnel junction structure of claim 18, in which the
2 second semiconductor material comprises gallium and two or more of nitrogen,
3 arsenic, antimony and bismuth.
- 1 22. (Original) The tunnel junction structure of claim 18, in which:
2 the first semiconductor material consists essentially of gallium indium nitride
3 arsenide (GaInNAs); and
4 the second semiconductor material consists essentially of gallium nitride
5 arsenide antimonide (GaNAsSb).
- 1 23. (Original) The tunnel junction structure of claim 22, in which:
2 the first semiconductor material consists essentially of gallium indium nitride
3 arsenide $\text{Ga}_{1-w}\text{In}_w\text{N}_x\text{As}_{1-x}$, in which $w \leq 0.4$ and $x \leq 0.15$; and
4 the second semiconductor material consists essentially of gallium nitride
5 arsenide antimonide $\text{GaN}_y\text{As}_{1-y-z}\text{Sb}_z$ in which $y \leq 0.15$ and $z \leq 0.3$.